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Complete Specification entitled (54) SELF-LOCKING NUT

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Related Art (56) Nil

The following statement is a full description of this invention, including the best method of performing it known to us :

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L159-54-2D-8PC

This invention relates to a self-locking nut of the type which utilises an annular ring of polymeric plastic material.

Self-locking nuts of steel are well known wherein the steel has a hexagon outer surface and a threaded inner surface to threadably engage a complementary stud, screw or bolt, and the steel having a recess containing an annular ring of nylon or other polymeric plastic material which becomes deformed as the nut is screwed on the end of a bolt or other male threaded member. This deformation of the ring of nylon results in a firm grip of the nylon (which through plastic memory tends to return to original shape) and the nuts are therefore termed "self-locking". However the nylon ring is captive within its recess without expansion room, the ring being constrained by the outer circular wall of the recess against radially outward deformation, and due to danger of damage to the nylon it is not recommended that such nuts should be used more than once or twice. Since the nylon cannot readily deform outwardly, yet must conform to the thread shape, it tends to tear, and thereby to lose its self-locking properties.

The main object of this invention is to provide a nut of improved self-locking characteristics, and which can be used time after time without seriously effecting the self-locking properties of the nut.

The invention in one of its forms may consist of a nut having a metal portion containing a relatively unyielding metal portion surrounding a female thread, a sleeve of

resilient resin based plastic material having an opening extending therethrough co-axial with the thread but of smaller diameter than the outer diameter thereof, and means retaining the sleeve to the metal portion, characterized in that an end of the retaining sleeve is relatively yieldable and is unconstrained against radially outward deformation whereby upon threadable engagement over a male threaded member, the sleeve end is deformed radially outwardly and frictionally engages the male threaded member. The sleeve may be of conical outer shape and be contained within parallel retaining walls in the nut; it may extend outwardly of the nut; the sleeve can be of cylindrical shape and contained within a tapered aperture in the nut, or may take any one of a number of alternative configurations within this invention. The inner diameter of the polymeric plastic ring is necessarily less than the outer diameter of the thread, but may be more than the root diameter.

Several embodiments of the invention are described hereunder in some detail with reference to and are illustrated in the accompanying drawings, in which:-

Fig. 1 is a central elevational section through a nut according to a first embodiment, and showing in dotted lines the radially outward deformation of the resilient sleeve,

Fig. 2 is a similar section through a nut according to a second embodiment,

Fig. 3 is a plan view of Fig. 2,

Fig. 4 is a central elevational section through a nut according to a third embodiment,

Fig. 5 is a central elevational section through a nut according to a fourth embodiment, and

Fig. 6 is a central elevational section through a nut according to a fifth embodiment.

In the first embodiment of Fig. 1 a metal nut 10 is first formed from hexagon or square stock having an aperture cut therein and a female thread 11 cut in the aperture. One end of the stock however is recessed to provide a counter-bore 12 of larger diameter than the outer diameter of the thread 11.

A polymeric plastic retaining sleeve 14 is formed from nylon by the injection moulding process, the polymeric plastic sleeve having a central opening 15 of diameter less than the outer diameter of the thread 11, and preferably more than its root diameter. The plastic sleeve 14 is provided with an outer shoulder 16 at one end and this is complementary in size to the counter-bore 12, so that the sleeve can be positioned in the end of the nut. The counter-bore is of greater depth than the depth of the shoulder however and the material surrounding the counter-bore 12 is formed inwardly to thereby retain the polymeric plastics sleeve 14.

The sleeve 14 is formed with a projecting end 17 having a tapered outer surface, while at its other end the opening 15 terminates in a taper 18 of increasing diameter, the arrangement is such that upon insertion of a male threaded member the interference with the tapered end 18 is so little that constraint against radial expansion of the shoulder portion is of very limited effect, but the tapered end 17 of the sleeve in being unconstrained expands outwardly radially as the male

thread enters the ring, thereby applying an elastic force inwardly against the male thread without excessive deformation of the ring material. The dotted lines in Fig. 1 illustrate the manner in which deformation takes place. This reduced interference substantially avoids the difficulty previously encountered with the rigidly retained rings which tend to tear. It is found that a nut made in accordance with the above embodiment will be useful time after time and still retain its self-locking properties several times better than when a constrained ring is used.

In the second embodiment of Figures 2 and 3 the metal nut portion 20 is again formed from hexagon stock containing a female thread 21 which opens into a counter-bore 22 at one end of the nut. A plastic sleeve 24 again of nylon has a central opening 25 extending through it, the plastic sleeve 24 having a shoulder 26 at one end, and a projecting end 27 projecting upwardly from the shoulder being unconstrained against radially outward deformation. The other end of the opening 25 is tapered at 28 to give a lead-in for the male threaded member when engaged by the female thread 21. The metal surrounding the shoulder 26 is formed inwardly upon assembly of the sleeve 24 of the nut 20, and at the same time a plurality of inwardly formed projections 29 ensure against relative rotation between the metal nut 20 and the sleeve 24. The nut functions in like manner to the nut of the first embodiment, departing therefrom mainly in the formation of the metal which retains the sleeve to the nut. In the first embodiment of Fig. 1 this metal is turned inwardly and downwardly,

while in Figures 2 and 3 it is merely deformed inwardly to a frusto-conical shape.

The third embodiment of Figure 4 again incorporates a frusto-conical inward formation of metal to retain a plastic sleeve. In this embodiment a metal nut portion 30 contains a female thread 31 which terminates at one end in a counter-bore 32, counter-bore 32 including a recess which extends outwardly from the end of the thread 31, and a plastic sleeve 34 of general frusto-conical shape is contained within the counter-bore 32. The metal of the nut surrounds the frusto-conical sleeve 34 and is so shaped that it engages the outer surface of the sleeve 34 for the inner part of its length but not for the outer part. The sleeve 34 in being of the frusto-conical shape has the diameter of its opening 35 reducing away from the thread, the smallest diameter being less than the outer diameter of the thread 31 and unconstrained against radially outward deformation. Since the opening 35 is tapered it will be seen that the end of the sleeve adjacent the thread 31 automatically provides a lead-in effect for a male threaded member while the end 37 of the smaller diameter will extend radially outwardly without the constraint of the metal surrounding it as the male threaded member progresses through the nut.

The function therefore, will be similar to the function of the arrangements described in the first and second embodiments. However, the third embodiment has the additional advantage that the plastic sleeve 34 may be positioned in the counter-bore 32 by a simple pressing operation, thus avoiding

the need for a subsequent forming operation of nut since the plastic sleeve 34 may be of material which is sufficiently deformable and yieldable to have its end deformed inwardly as it passes through the throat 39 within the material surrounding the nut counter-bore 32.

When a plastic material is moulded it shrinks considerably more than metal of the same temperature upon cooling. The embodiment of Fig. 5 takes advantage of this characteristic by utilizing as a metal nut portion 40 a rolled threaded tubular member having a female thread 41, and being surrounded by a nut body 42 of nylon material, the nut body 42 terminating at one end in a frusto-conical skirt 43 which functions as a sleeve, having a tapered opening 45 extending therethrough. The opening 45 in being tapered provides a lead-in at its end adjacent the metal nut portion 40, but its other end 47 of the skirt 43 has an inner diameter less than the outer diameter of the thread 41, so that as the nut progresses over a male threaded member the end 47 is free to expand radially outwardly so as to frictionally engage the male threaded member. Since the metal nut portion 40 contains a metal thread, that thread is capable of withstanding considerable forces and will not tend to tear as would a plastic thread, and since the nut body 42 tends to shrink upon moulding more than the metal nut 40 if heated to the same temperature, the metal nut 40 may be simply inserted in a die and the plastic material moulded thereabout. Thus it will be seen that not only does the nut have the excellent locking qualities afforded by this invention, but it is also of low cost and its outer surface of non-corrosive

material.

Referring now to the fifth embodiment which is illustrated in Fig. 6 again use is made of the characteristic of a plastic material shrinking more than steel or other metal, and a metal nut portion 50 containing a thread 51, is positioned in a die and has a nut body 52 moulded around it as in the fourth embodiment. The nut body 52 is formed with a skirt 53 containing a thread 54 which is not, however, parallel but tapers inwardly away from the metal nut 50. Thus, when the nut is threadably engaged on a male threaded member the thread 54 also engages the male threaded member but with increasing friction towards its end due to the elastic properties of the nut body 52. There is a greater surface area of contact than in the fourth embodiment due to the formed thread.

The metal nut portion 50 is provided with a lower hexagonal flange 56 the outer faces of which align with hexagonal faces on the plastic nut body 52 so that the additional strength of the metal is available not only for the female thread 51 but also for the spanner faces of the nut.

It will be seen that in all the above embodiments the nut has a relatively unyielding portion and a sleeve of resilient material which is characterised by being relatively yieldable and unconstrained against radially outward deformation. It is found that a sleeve so formed shows much less tendency to tear and thus become damaged and the nut may be regarded as a re-usable nut. It retains its self-locking characteristics over an extended period of time, and under many conditions of usage it locks with more efficiency than alternative self-locking nuts which utilize plastic rings constrained against outward deformation.

The claims defining the invention are as follows:-

1. A nut having a metal portion containing a relatively unyielding metal portion surrounding a female thread, a sleeve of resilient resin based plastic material having an opening extending therethrough co-axial with the thread but of smaller diameter than the outer diameter thereof, and means retaining the sleeve to the metal portion, characterized in that an end of the retaining sleeve is relatively yieldable and is unconstrained against radially outward deformation whereby upon threadable engagement over a male threaded member, the sleeve end is deformed radially outwardly and frictionally engages the male threaded member.

2. A nut according to Claim 1 wherein the metal portion contains a counter-bore and the plastic sleeve is provided with a shoulder positioned within the counter-bore.

3. A nut according to Claim 2 wherein metal surrounding the counter-bore is formed over the plastic sleeve shoulder thereby retaining the plastic sleeve in the counter-bore.

4. A nut according to either Claim 2 or Claim 3 wherein the metal surrounding the counter-bore has a plurality of inwardly extending projections engaging the shoulder and retaining the sleeve against rotation relative to the nut.

5. A nut according to any one of the preceding claims wherein the plastic sleeve has a skirt extending outwardly

away from the metal nut portion in an axial direction, and the walls defining the opening of the sleeve increase in diameter towards the thread.

6. A nut according to Claim 1 wherein the metal nut portion contains a counter-bore and the plastic sleeve is of frusto-conical shape which is contained within the counter-bore.

7. A nut according to Claim 1 containing a metal portion of tubular form and a nut body of resilient resin based plastic material, the sleeve being in the form of a skirt being integral with the nut body.

8. A nut according to Claim 7 wherein the skirt is of frusto-conical shape.

9. A nut according to either Claim 7 or Claim 8 wherein the skirt contains a thread continuous with the thread of the metal nut portion but of reducing diameter as it extends away from the metal nut portion in an axial direction.

10. A nut constructed substantially according to the embodiment described in the specification with reference to and as illustrated in Fig. 1 in the accompanying drawings.

11. A nut constructed substantially according to the embodiment described in the specification with reference to and as illustrated in Figs. 2 and 3 in the accompanying drawings.

12. A nut constructed substantially according to the embodiment described in the specification with reference to and as illustrated in Fig. 4 in the accompanying drawings.

13. A nut constructed substantially according to the embodiment described in the specification with reference to and as illustrated in Fig. 5 in the accompanying drawings.

14. A nut constructed substantially according to the embodiment described in the specification with reference to and as illustrated in Fig. 6 in the accompanying drawings.

Dated this 20th day of July 1970.

GLEN NORMAN PADGET and PAMELA GAY PADGET,

By their Patent Attorneys,
R.K. MADDERN & ASSOCIATES.

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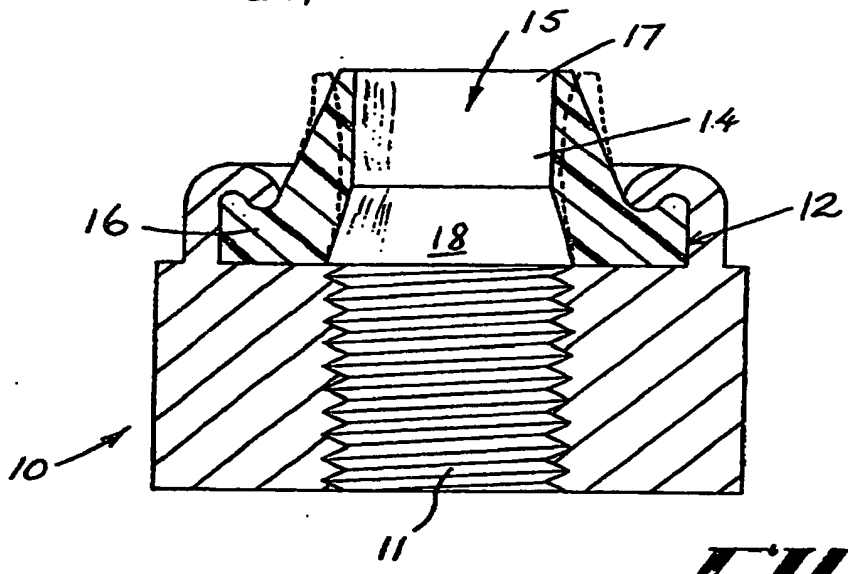

FIG 1

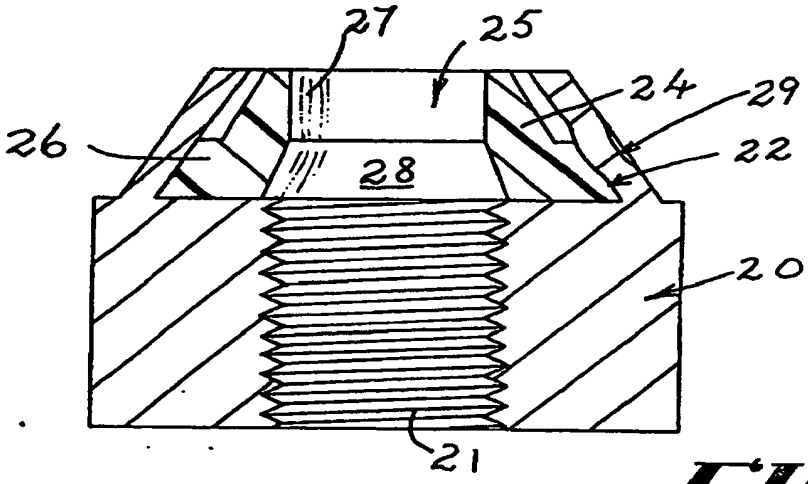

FIG 2

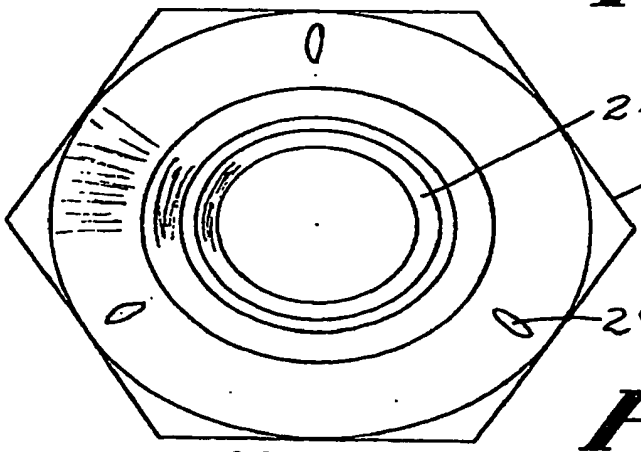

FIG 3

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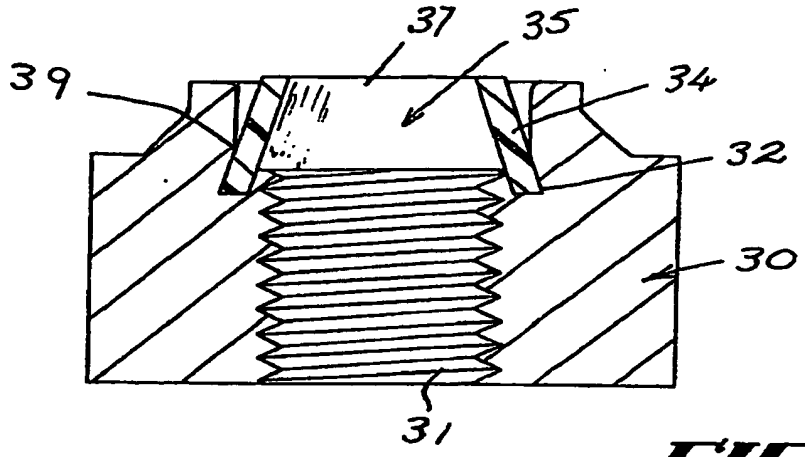


FIG 4

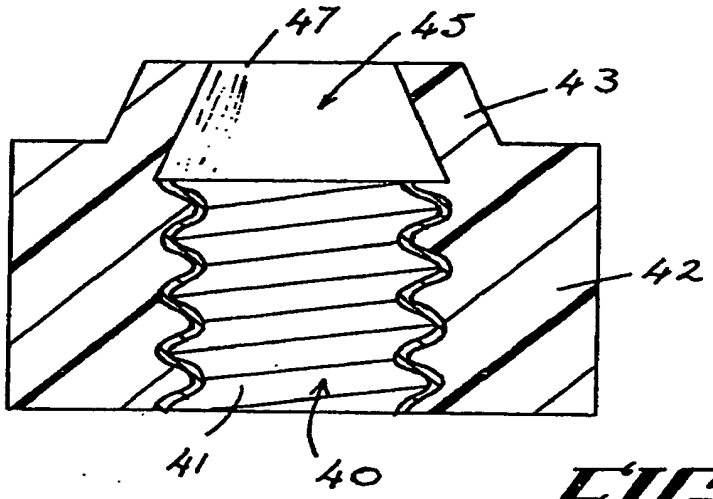
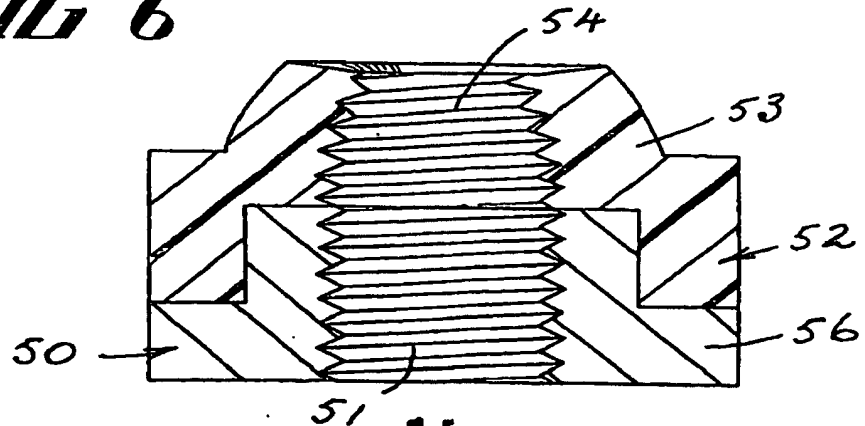


FIG 5

FIG 6



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